THE FLORA, VEGETATION, AND PHYTOGEOGRAPHIC RELATIONSHIPS OF WHALEBOAT ISLAND, CASCO BAY, MAINE

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Despite the numerous relatively undisturbed islands in the Gulf of Maine and the increasing interest in island biogeography, few Maine island floras have been adequately studied. The flora of Mount Desert Island is probably the best known, from the descriptions of Rand and Redfield (1894), Moore and Taylor (1927), and Wherry (1928). Other investigations include those of Matinicus Island (McAtee, 1916), Matinicus Rock, Machias Seal Island, and Gull Rock (Hodgdon & Pike, 1969), Isle au Haut (Wise, 1970), and the Kent Islands in the Bay of Fundy (McCain et al., 1973; McCain, 1975). Studies of the Penobscot Bay area (Hill, 1919; 1923) and coastal spruce-fir forests (Davis, 1961) provide additional data for the region. During 1975 and 1976, I inventoried the vascular plant flora of Whaleboat Island, Casco Bay, Maine, and carried out phytosociological investigations of the island's spruce forests. This paper is a compilation of the Whaleboat Island flora and a discussion of the island's vegetation and biogeographic relationships.

Whaleboat Island lies at 43° 45′N latitude and 70° 03′W longitude, among the middle tier of the 222 offshore islands in Casco Bay. The 47-hectare island is approximately 2.7 km long, and varies in width from 100–400 m. It is protected from full marine exposure by a series of outer islands, and lies 1.3 km west of Harpswell Neck, a narrow promontory that extends some 22.5 km into the middle of the bay. Elevated, heavily wooded sections at each end are connected by a low, grassy swale, producing the physiographic configuration which inspired the island's name.

Whaleboat Island lies in an area of transition between a more southern coastline, dominated by long beaches with sand produced by the erosion of glacial deposits, and a rocky northern coastline which has no large glacial deposits and has experienced relatively little erosion (Leavitt, 1935). A few small, poorly developed silt and sand beaches and a salt marsh occur on the island's protected east side. Elsewhere the island is bounded by steep cliffs, rock, and shingle beaches. A large erratic is poised on the rocky edge of the southern tip.

Whaleboat Island and many of the other islands in Casco Bay are underlain by Cambro-Ordovician schists of the Cushing Formation (Hussey & Pankiwskyj, 1975), characterized by varying muscovite and biotite content in vertical laminae. Eighty percent of the island is covered by strongly acid, very well drained coarse-textured soils that were formed in glacial till. Depth to bedrock in these soils is 30–45 cm, and outcrops are common. A deeper, less well drained soil occupies a strip of the island near its center (U.S.D.A. Soil Conservation Service, 1974).

A vegetational transition also occurs in this area between coastal and boreal spruce-fir forests to the north and east and hardwoods-white pine-hemlock forests in the southwest and central interior (Westveld et al., 1956; Davis, 1961). Whaleboat Island supports two spruce forests, located on the hills at either end of the island. The low area between the forests is dominated by grasses with coarse shrubs and small trees on slightly higher ground. The southern tip of the island is covered largely by shrubs.

The climate of the area is strongly affected by offshore currents. The confluence of the cold Labrador Current and the warmer Gulf Stream some miles offshore results in frequent heavy fog. Coastal storms or "northeasters", bringing high winds and heavy precipitation, are often accompanied by high wind-driven tides and ice storms. Because of the moderating influence of the sea, coastal Maine experiences the coolest summers, warmest winters, longest growing season, and narrowest range between temperature extremes of any region of the state (Lautzenheiser, 1972).

Whaleboat Island, presently uninhabited, supported a small human population as late as 1905 (Etnier, 1974). An Indian shell mound on the northwest side of the island suggests a long history of human visitation. Other evidence of occupation are stone walls, an old dug well, and, near the southern end, the remains of a small shed that was used intermittently by rum traders in the 1920's. Present human disturbance is usually limited to the immediate shoreline. Turkeys, sheep, and cattle were formerly kept on the island, the latter until the 1950's. The island's southern half is now protected under a conservation easement granted to the Maine Department of Parks and Recreation. Whaleboat Island is listed as one of Maine's "Natural Areas."

VEGETATION

The island forests are dominated by red spruce, *Picea rubens*. Minor elements in the canopy are *Abies balsamea* and *Betula papyrifera*. The understory, where not occupied solely by windthrown trees and litter, is dominated by *Dryopteris spinulosa, Cornus canadensis,* and *Trientalis borealis*. Shrubs are rare. Areas adjacent to freshwater springs support heavy growths of *Scirpus cyperinus, Hypericum virginicum,* and *Sphagnum* spp. Larger openings in the forest tend to be populated exclusively by *Dennstaedtia punctilobula,* while smaller openings are dominated by *Dryopteris spinulosa* and *Pteridium aquilinum*.

The spruce forests appear to be fairly mature. This vegetation type on Whaleboat Island exhibits substantially lower species diversity than most others on the island and contains exclusively native species. *Populus tremuloides, Betula lenta, Quercus rubra,* and *Prunus pensylvanica*, common in nearby mainland forests, are restricted to the edges of the Whaleboat Island forests.

The forest edge supports an assemblage of high species diversity. Many species, including *Salix discolor, Dirca palustris,* and *Viburnum recognitum,* are represented here by single individuals. *Juniperus communis, Myrica pensylvanica, Rubus idaeus,* and *Vaccinium angustifolium* are particularly successful shrubs. *Rumex acetosella, Fragaria virginiana, Ligusticum scothicum,* and *Achillea millefolium* are prominent herbs. Throughout much of the island this assemblage occurs as a narrow band on the cliffs between the shoreline and the forest.

Most of the central part of the island between the forests, as well as the southern tip, supports a dense growth of shrubs, particularly *Rosa rugosa, Rubus idaeus,* and *Myrica pensylvanica,* interrupted by a few small, isolated individuals of white pine, *Pinus strobus,* alder, *Alnus rugosa,* and red maple, *Acer rubrum*. Colonies of *Urtica dioica* and *Solidago rugosa* and other coarse herbs are scattered throughout the area.

Comparison of an aerial photograph taken in 1956 (USGS-VLE 1-4) just after the cessation of grazing, with a similar photograph taken in 1970 (USGS-VLCK-C 1-17) shows that the thick shrub cover has encroached upon the adjacent grasslands to some extent. When the central part of the island was forested, it probably supported a mixed white pine-hardwoods forest similar to the forests

present on most of the other islands and peninsulas in the bay. It is likely that this area was cleared by the settlers, and, following abandonment, was quickly colonized by shrubs. Although several stunted red maples, white pines, and a red spruce now rise above the thick shrub cover, no seedling or sapling reproduction of these or other tree species is apparently occurring on the site. The adjacent edge of the forest is marked by a fringe of juniper (*Juniperus communis*) and dewberry (*Rubus flagellaris*) on exposed bedrock ledges.

This shrub community appears to have been relatively stable for at least the last 20 years, in the sense that the development of a tree-dominated community on the site does not appear to be imminent. Tree species may be largely excluded by the density of the shrubs, the smothering effect of their litter upon tree seedlings, and the ability of shrubs such as *Rubus idaeus* to spread quickly by suckering. Similar situations have been documented elsewhere (Pound & Egler, 1953; Niering & Egler, 1955; Niering & Goodwin, 1974). The competitive advantage possessed by spruce and fir on shallow, well drained upland soils elsewhere on the island apparently is not maintained in the deeper, moister soil at the center, and it is possible that this area may remain dominated by shrubs for an indefinite period of time.

A narrow strip of grassland on low ground at the island's center and another on the extreme southern tip are dominated by *Agrostis tenuis, Danthonia spicata,* and *Poa pratensis,* with *Ribes glandulosum, Rubus hispidus,* and *Cirsium arvense* also common.

The precise effects of grazing upon the plant species composition in the grasslands is difficult to determine. Some species such as the highly palatable *Trifolium repens* may have been markedly reduced in abundance. Only one individual of *T. repens* was observed on the island, although it is common elsewhere along the coast (Hill, 1923). Species representing genera which are less palatable and possess spines or prickles, including *Ribes, Rosa, Rubus, Urtica,* and *Cirsium,* are now prominent in the vegetation. The abundance of *Ribes* spp. has been used as an approximate measure of grazing pressure, since they are able to withstand prolonged grazing (Auclair & Cottam, 1971). Other species such as *Phleum pratense* still present in the vegetation may have been planted for pasturage.

The two meadows, sites of past human and animal activity, are slowly being invaded by shrubs, particularly bayberry, *Myrica pensylvanica,* wild rose, *Rosa rugosa,* and raspberry, *Rubus idaeus.*

Spruce does not appear to be colonizing the central grasslands, although the seed supply is sufficient. With increased colonization by raspberry and bayberry, conditions for the establishment of the conifers on the abandoned land may become more favorable. However, if storm tide overwash occurs on this low section, development of any woody vegetation besides bayberry and a few others is unlikely.

The shoreline communities on the island include a totally distinct group of species. Above the drift line, rock beaches are dominated by *Plantago juncoides* and *Solidago sempervirens,* pebble beaches by *Raphanus raphanistrum,* and beaches of finer substrate by *Elymus virginicus.* The drift line itself supports sporadic growths of *Chenopodium album* and *Sonchus asper.* The salt marsh on the eastern side of the island is dominated by *Spartina alterniflora, S. patens,* and *Salicornia europaea.*

PHYTOGEOGRAPHY

Islands often show different assemblages of species from similar mainland sites (MacArthur & Wilson, 1967; Power, 1972). The Whaleboat Island flora is somewhat depauperate in comparison with two Casco Bay mainland spruce forests studied by Davis (1961). Many species which are important on the mainland are completely absent from the island. These include *Pinus resinosa, Thuja occidentalis, Medeola virginiana, Cypripedium acaule, Betula populifolia, Coptis groenlandica, Nemopanthus mucronata, Acer pensylvanicum, Kalmia angustifolia,* and *Epigaea repens,* as well as others. *Dryopteris spinulosa,* the dominant species in the island forest understory, is either not present or is only a minor element in nearby mainland forests. (Davis, 1961).

MacArthur and Wilson (1967) suggest that species may occupy wider niches on species-depauperate islands because of the absence of competitors. On Whaleboat Island, many aggressive mainland competitors are present, yet their importance on the island appears to be restricted by the comparative success of a different group of species. For example, only one individual of *Taraxacum officinale* was observed on the island in 1976. It was growing not in the grassland, but just above the drift line. Other introduced species, including *Verbascum thapsus* and *Rumex crispus,* and locally abundant natives such as *Rhus radicans* tend to be largely restricted

to this area as well. They are replaced on the island by *Myrica pensylvanica,* a species highly adapted to succeed on nitrogen impoverished soils by nitrogen-fixing bacteria in its root nodules (Morris et al., 1974), and other species, including *Raphanus raphanistrum, Fragaria virginiana, Rosa rugosa,* and *Rubus idaeus.*

The depauperate nature of the island flora is also demonstrated by the large proportion of taxa which are represented by only one species. This characteristic was noted by McCain (1975) in his study of the Kent Island group. Table 1 shows the generic coefficient (total genera/total species × 100) of Whaleboat Island and seven other islands from the New England coast.

The reduced species diversity of these island floras is evident when they are compared to a mainland flora. The generic coefficient of the Penobscot Bay area flora (Hill, 1919) is 50, compared to a range of 60–91 among the island floras. This lower diversity reflects reduced ecological diversity of island habitats. This is readily apparent from the generic coefficient of 91 for Gull Rock, a very small island of only several hectares. The results of this study and comparison to those of similar islands tend to corroborate the findings of MacArthur and Wilson (1967), who attribute higher genus/species ratios in island faunas as well as floras to competitive replacement in the more restrictive island habitats.

The species diversity of these island floras shows a strong relationship to area. The number of species increases rapidly with increasing island area until islands as large as Kent and Cuttyhunk are reached. The relative difficulty of colonization of more distant islands is also apparent. Matinicus Island, although more than four times the size of either Kent Island or Cuttyhunk, lies at least 5 km farther from the mainland and supports fewer species. Matinicus Rock is approximately the same size as Machias Seal Island but is 13 km farther out to sea and supports 13 fewer species.

The archipelago effect, or the influence of nearby islands acting as stepping stones for mainland colonists, is also demonstrated in Table 1. Cuttyhunk, a member of the Elizabeth Islands chain in Buzzards Bay, Massachusetts, and Kent Island, part of the Grand Manan archipelago of New Brunswick, support far more species than oceanic Matinicus Island. Similarly, Penikese, also in the Elizabeth chain, is much farther from the mainland and smaller in area than Whaleboat, but supports a flora of comparable size.

A distinctive attribute of the Whaleboat Island flora is the low complement of introduced species. Table 1 also shows the percentage of non-native species in the eight New England island floras. The largest value is 47%, reported for Penikese Island. Previous collections on this island have yielded even higher percentages of alien elements (Lauermann & Burk, 1976). These authors cite previous human habitation, and dispersal by herring gulls which forage in mainland dump sites, among reasons for the high value.

Other workers have noted the effects of disturbance by large colonies of nesting seabirds upon island floras. Hodgdon and Pike (1969) suggest that bird islands may become largely populated by introduced weeds or by locally abundant natives following the initial elimination of many species by the new bird colonies. However, the lowest percentage of non-native species in Table 1 is 17%, shown for Kent Island. In view of the large nesting herring gull population on Kent Island (McCain et al., 1973), this value is surprisingly low when compared to those of other bird islands, Gull Rock, Machias Seal Island, and Matinicus Rock. The major families constituting the flora of these three islands are the Compositae, Gramineae, Polygonaceae, Caryophyllaceae, and Leguminosae, which together comprise a little over 50% of the flora (Hodgdon & Pike, 1969). In comparison, these taxa comprise only 25% of the Whaleboat Island flora. Nesting birds do not appear to be important agents of disturbance on Whaleboat Island. Although eiders, osprey, and a number of smaller passerine species nest in moderate numbers on the island, only two nesting pairs of herring gulls were observed in 1976.

While the proportion of alien elements is not always directly related to disturbance from nesting birds, a slight trend of increasing proportion of introduced species with decreasing latitude appears. This trend may be related to increasing proximity to areas that have been populated for the longest period of time.

All of these islands have sustained some type of major disturbance. Matinicus, Whaleboat, Cuttyhunk, and Penikese have been or are currently inhabited, and all have probably been grazed to some extent. Kent Island, Gull Rock, Machias Seal, Matinicus Rock, and Penikese also support nesting bird colonies of significant size.

Table 1. Phytogeographic relationships of eight New England island floras

Island	Area(ha)	Distance from mainland (km)	Latitude	Number of Species	Generic Coefficient	% Non-Native Species	Index of floristic resemblance to Whaleboat Island
[1]Matinicus Island	291	29	43° 52′	217	75	34	50.0
[2]Kent Island	61	24	44° 35′	224	60	17	49.4
[3]Cuttyhunk Island	61	21	41° 27′	260	64	29	29.2
Whaleboat Island	47	1.3	43° 45′	168	60	20	—
[4]Penikese Island	34	19	41° 27′	163	73	47	32.5
[5]Machias Seal Island	4	18	44° 39′	77	68	35	32.5
[5]Matinicus Rock	4	31	43° 52′	64	75	34	40.6
[5]Gull Rock	2	13	44° 55′	34	91	24	32.4

Sources:
[1]McAtee, 1916
[2]McCain, Hodgdon, and Pike, 1969
[3]O'Neill, 1975
[4]Lauermann and Burk, 1976
[5]Hodgdon and Pike, 1969

The Simpson index of resemblance has been used to compare the taxonomic composition of the total floras of each island with that of Whaleboat Island, according to the formula $100\,C/n_1$, in which C is the number of taxonomic units common to two floras, and n_1 is the total number of units in the smaller of the two (Simpson, 1965). This index is most useful for comparison of floras of similar size. The resemblance indices are included in Table 1.

Whaleboat Island shows the greatest floristic resemblance to Matinicus Island and Kent Island. Both of these support spruce forests and shrub communities similar to those on Whaleboat, and both have similar percentages of introduced species. They are also the largest of the six islands located in the Gulf of Maine.

Although the families represented on Gull Rock, Machias Seal Island, and Matinicus Rock are essentially all represented on Whaleboat as well, resemblance at the species level is markedly lower. In spite of the fact that the islands lie within the same geographic and climax vegetation zones as Whaleboat Island, resemblance is no higher than that between Whaleboat and the two Elizabeth islands. Smaller size and reduced habitat diversity appear to be more important than geographic or vegetational proximity. The somewhat higher resemblance of Whaleboat to Matinicus Rock may reflect the physical proximity of that island to Matinicus Island.

The two Elizabeth islands lie within a different climax forest vegetation zone (Westveld et al., 1956). The floras of these islands and the other two bird islands in Maine show a degree of floristic resemblance to Whaleboat Island not unlike that found between Cape Cod and the Outer Banks of North Carolina by Burk (1968). Examination of the species lists reveals that the major points of similarity among the islands are the shoreline and shrub communities, as also found by Burk. Many drift line colonists, introduced species, and unpalatable forms are common to all of these islands. Despite differences in climax vegetation, these segments of the floras converge taxonomically because of the common influences of human habitation, grazing, and marine exposure.

FLORA OF WHALEBOAT ISLAND

Sixteen days were spent on six separate visits to the island during the fall of 1975 and the spring and summer of 1976. Specimens of all vascular plant species were collected, and observations on the abundance of each species were recorded.

A total of 168 species of vascular plants, representing 110 genera and 51 families, were collected on Whaleboat Island. Of these, 136 are native and 32 are non-native, chiefly introduced from Europe.

All of the plants collected on the island had been previously reported in the area except *Dryopteris fragrans,* the fragrant wood fern, which was growing in three small clumps on a dry ledge on the northwest side. The nearest previously known station is some 97 km north and east of Whaleboat Island (Seymour, 1969).

Nomenclature follows Fernald (1950). All specimens collected in the course of this study have been deposited in the herbarium of Smith College. Species marked by asterisk in the checklist are alien.

ANNOTATED CHECKLIST

EQUISETACEAE

Equisetum arvense — uncommon at the spring on the southern tip
E. sylvaticum — rare in the central shrub thicket

LYCOPODIACEAE

Lycopodium obscurum — rare on moist ground in the forests

OSMUNDACEAE

Osmunda cinnamomea — common on moist ground in the southern forest

POLYPODIACEAE

Dennstaedtia punctilobula — abundant in the larger forest openings
Dryopteris fragrans — rare; in three small clumps on a mossy ledge on the northwest margin of the northern forest
D. noveboracensis — uncommon in the central shrub thicket
D. phegopteris — locally common at the spring on the southern tip, in the central shrub thicket, and rare in the northern forest
D. spinulosa — the most abundant fern in the spruce forests
D. thelypteris — common in the central shrub thicket
Onoclea sensibilis — locally abundant in the central shrub thicket and near the spring on the southern tip
Pteridium aquilinum — locally abundant in openings in the forests

PINACEAE

Abies balsamea — rare in the forests
Juniperus communis — abundant on bedrock outcrops at the forest margins

Picea rubens — abundant in the spruce forests
Pinus strobus — rare in the central shrub thicket

JUNCAGINACEAE

Triglochin maritimum — locally common in the salt marsh

GRAMINEAE

**Agrostis tenuis* — dominant grass in the central meadow
Danthonia spicata — common in moist soil on the western side in the shrub thicket and in the grassland
Elymus arenarius — uncommon in the drift line, east central side
E. virginicus — locally common in the drift line
**Phleum pratense* — common in the central meadow
Poa pratensis — common in the central meadow
Spartina alterniflora — common locally in the drift line on finer substrate
S. patens — locally common in wet soils on the western side above the drift line
S. pectinata — locally common in wet soils on the western side

CYPERACEAE

Carex hystricina — locally common at the spring on the southern tip
C. scoparia — uncommon above the drift line, central
C. silicea — locally common on the east central side
Scirpus atrocinctus — uncommon in the drift line, east side
S. cyperinus — abundant at springs in the forests
S. maritimus — locally common on the mud flat, eastern shore

JUNCACEAE

Juncus balticus — uncommon in the central meadow
J. gerardi — locally common in the drift line, east central
J. tenuis — locally common on the east central shore

LILIACEAE

Erythronium americanum — rare in the southern spruce forest
Maianthemum canadense — common in the forests

IRIDACEAE

Iris versicolor — rare on ledges on the northern forest margin and on the west side of the grassland

SALICACEAE

Populus tremuloides — locally common in a restricted area southwest of the northern forest and uncommon elsewhere on the forest edges

Salix discolor — one individual at the campsite on the northwest side

MYRICACEAE

Myrica pensylvanica — abundant in the central shrub thicket and on forest margins throughout

CORYLACEAE

Alnus rugosa — several large individuals in the central shrub thicket

Betula lenta — rare on the northwest forest margin

B. lutea — rare in the northern forest

B. papyrifera — common in the northern forest, rare in the southern forest

FAGACEAE

Quercus rubra — rare on the western edge of the northern forest

URTICACEAE

**Urtica dioica* — common in the central shrub thicket

POLYGONACEAE

Polygonum hydropiper — uncommon in wet soil, west central shrub margin

P. punctatum — locally abundant at the spring on the southern tip

P. sagittatum — uncommon on the western central shrub margin

**Rumex acetosella* — common on dry ledges

**R. crispus* — uncommon above the drift line, central area

CHENOPODIACEAE

Atriplex patula — uncommon in the drift line, east central

**Chenopodium album* — common in the drift line, stony beaches

Salicornia europaea — locally common in the salt marsh and in finer substrate in the drift line, east side

Suaeda maritima — uncommon in the drift line, stony beaches

CARYOPHYLLACEAE

Arenaria lateriflora — uncommon in the central meadow

**Cerastium vulgatum* — common in the central meadow

Spergularia rubra — uncommon on the southern end

RANUNCULACEAE

Anemone quinquefolia — rare in the spruce forests

CRUCIFERAE

**Brassica juncea* — rare just above the drift line, west side
**B. kaber* — rare just above the drift line
**B. nigra* — uncommon in the drift line on the northeast side
Cakile edentula — locally common in the drift line, east side
**Capsella bursa-pastoris* — rare in rocky crevices, northeast side
**Raphanus raphanistru;m* — dominant plant just above the drift line in most areas

SAXIFRAGACEAE

Ribes glandulosum — common in shrubby areas throughout
R. hirtellum — locally abundant on the southern tip

ROSACEAE

Amelanchier stolonifera — rare in the central shrub thicket
Fragaria virginiana — abundant on dry ledges and meadows throughout
Geum aleppicum — uncommon on the forest margin, northeast side
Potentilla anserina — common above the drift line
**P. argentea* — common in the central meadow
P. norvegica — uncommon in the central meadow
P. simplex — rare above the drift line, east central
P. tridentata — common on dry ledges, near the central meadow
Prunus pensylvanica — locally common at the forest margin, northwest side
Pyrus arbutifolia — uncommon in the central shrub thicket
**P. malus* — a single large individual at the southern margin of the northern forest near the stone wall
P. melanocarpa — locally abundant in a small area on the western shrub margin
**Rosa rugosa* — abundant above the drift line and in shrubby areas throughout
R. virginiana — common above the drift line and in shrubby areas
Rubus allegheniensis — locally common except in the meadow
R. flagellaris — abundant in the central meadow, the central shrub thicket, and on the southern tip
R. hispidus — abundant in the central meadow and in shrubby areas

R. idaeus — dominant in the central shrub thicket, common on the southern tip
R. semisetosus — rare in openings in the spruce forests
Spiraea latifolia — locally common in the central shrub thicket
S. tomentosa — locally common in the central shrub thicket

LEGUMINOSAE

Lathyrus japonicus — common in the drift line, east and west
**Trifolium arvense* — uncommon on dry ledges
**T. repens* — rare on the southern tip

OXALIDACEAE

Oxalis corniculata — rare in the spruce forests and uncommon on dry ledges

GERANIACEAE

Geranium bicknellii — rare on the west central side, shrub margin

POLYGALACEAE

Polygala sanguinea — locally common on the west central shrub margin

ANACARDIACEAE

Rhus radicans — locally abundant in one small area on the west central shrub margin
R. typhina — locally common in one area on the southeast margin of the northern forest, close to the shore

AQUIFOLIACEAE

Ilex verticillata — common in the central shrub thicket in moist soil, rare on the western margin of the southern forest

ACERACEAE

Acer rubrum — uncommon in the central shrub thicket and on ledges on the eastern cliffs by the southern forest

BALSAMINACEAE

Impatiens capensis — locally common on the northeast forest margin and in wet soil on the west central shrub margin

GUTTIFERAE

**Hypericum perforatum* — common above the drift line, central
H. punctatum — uncommon above the drift line, west central shrub margin

H. virginicum — locally abundant in moist depressions in the forests and in moist soil in the central shrub thicket

VIOLACEAE

Viola lanceolata — rare on moss on the northwest side
V. septentrionalis — common on moss on the northwest side and on the west central shrub margin

THYMELACEAE

Dirca palustris — a single individual on a rocky ledge on the northwest side

ONAGRACEAE

Circaea alpina — common in the central shrub thicket
Epilobium glandulosum — common above the drift line, central
E. leptophyllum — uncommon in shrubby areas on the southern end
Oenothera biennis — uncommon above the drift line
O. perennis — rare in moist soil on the west central shrub margin

ARALIACEAE

Aralia nudicaulis — rare in the northern forest
Panax trifolius — uncommon in openings in the southern forest

UMBELLIFERAE

Heracleum maximum — single group of plants on the eastern margin of the northern forest
Ligusticum scothicum — abundant on dry rocky ledges throughout

CORNACEAE

Cornus canadensis — common throughout the spruce forests

ERICACEAE

Vaccinium angustifolium — abundant in the central shrub thicket, common along forest margins, uncommon in the forests
V. corymbosum — uncommon near the forest on the southern tip, rare in the southern forest
V. macrocarpon — locally abundant only on the spring on the southern tip
V. vitis-idaea — uncommon on dry ledges, southern end

PRIMULACEAE

Glaux maritima — uncommon in finer substrate, drift line east side
Lysimachia quadrifolia — rare in the spruce forest

L. terrestris — common in the central shrub zone, uncommon on the southern tip
Trientalis borealis — abundant in the spruce forests

PLUMBAGINACEAE

Limonium nashii — common in rock crevices on the shore and abundant in the rocky cove on the central west side

ASCLEPIADACEAE

Asclepias syriaca — uncommon on the northeast forest margin and in the central grassland

CONVOLVULACEAE

Convolvulus sepium — common above the drift line in moist soil
Cuscuta gronovii — locally abundant in a single location in wet soil on west central shrub margin

VERBENACEAE

Verbena hastata — locally common in wet soil, on the west central shrub margin

LABIATAE

**Galeopsis tetrahit* — uncommon above the drift line, east side
Lycopus americanus — uncommon in wet soil on the west central shrub margin
L. uniflorus — abundant on dry ledges throughout
**Nepeta cataria* — uncommon above the drift line, east central
Scutellaria epilobiifolia — locally abundant just above the drift line
Teucrium canadense — common above the drift line, east central

SOLANACEAE

**Solanum dulcamara* — uncommon above the drift line, east central

SCROPHULARIACEAE

Linaria canadensis — uncommon on the southeast side
Rhinanthus crista-galli — rare above the drift line, east central
**Verbascum thapsus* — rare above the drift line, east central

PLANTAGINACEAE

Plantago juncoides — abundant in rock crevices on the shore

RUBIACEAE

Galium palustre — uncommon above the drift line, east central
Houstonia caerulea — abundant only on a dry ledge by the campsite on the northwest side

CAPRIFOLIACEAE

Sambucus canadensis — uncommon on the northeast forest margin
S. pubens — rare on the east side
Viburnum cassinoides — single individual on the southeast side
V. recognitum — single individual on the southeast margin of the northern forest

COMPOSITAE

**Achillea millefolium* — abundant on dry ledges throughout
Ambrosia artemisiifolia — uncommon in the shrub margin
Aster johannensis — uncommon on the west side
Bidens frondosa — locally common in wet soil on the west central shrub margin
**Chrysanthemum leucanthemum* — rare, above the drift line
**Cirsium arvense* — abundant in the central meadow
**C. vulgare* — common above the drift line, east central
Erigeron strigosus — uncommon on dry ledges, west central
Gnaphalium obtusifolium — uncommon on dry ledges, west central side
**Hieracium aurantiacum* — rare above the drift line, east central
**Senecio vulgaris* — locally common in the drift line, south and east
Solidago bicolor — rare, confined to a dry ledge on the west central side
S. juncea — uncommon in the central meadow
S. rugosa — common, central shrub area
S. sempervirens — abundant in rock crevices throughout and common on rocky beaches
S. sempervirens × *rugosa* (*S.* × *asperula*) — common in large colonies south of the northern forest and above the drift line in central sections
**Sonchus arvensis* — common in the drift line on rocky beaches
**S. asper* — common in the drift line on rocky beaches
**Taraxacum officinale* — rare above the drift line, east central shore

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